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Island Britain – Peninsula Britain: Palaeogeography, Colonisation, and the Lower Palaeolithic Settlement of the British Isles

By MARK J. WHITE[1] & DANIELLE C. SCHREVE[2]

Britain's geographical status has fluctuated between an island and a peninsula of Europe several times over the past 500 kya, as sea-levels rose and fell in response to global climate change. In this paper, we outline the currently available lithological and biological evidence for these fluctuations and use it to help construct an heuristic biogeographical framework of human colonisation, settlement, and abandonment, proposing mechanisms that are coupled with both regional palaeogeographical evolution and global climatic change. When used as a means of interpreting the archaeological record, the implications of this framework suggests not only that large-scale socio-culturally relevant patterns may indeed exist in the lithic record, but that these may possibly be understood as part of the ebb and flow of different regional populations, measured against the backdrop of changing climates and landscapes. It is suggested that the Clactonian and Acheulean may represent separate pulses of colonisation, possibly by different European populations, following abandonment during the height of glacial periods: the Clactonian reflecting an early recolonisation event during climatic amelioration, the Acheulean representing a second wave during the main interglacial. This phenomenon is recurrent, being observable during the first two post-Anglian interglacials. Other patterns in the lithic record are argued to reflect specific endemic technological developments among insular hominid populations during periods of isolation from mainland Europe. These represent some of the few patterns in the British Acheulean that cannot be interpreted more parsimoniously in terms of raw materials.

INTRODUCTION

Britain's current island status is a relatively recent development, with final separation from continental Europe occurring around 8500 BP (Jelgersma 1979; Lambeck 1993). For prehistorians studying the late Pleistocene and early Holocene, the implications of this insularity and foregoing peninsularity have been important in understanding colonisation, settlement histories, and culture change (Jacobi 1976; Barton & Roberts 1996; Housley *et al.* 1997; Coles 1998). Most research into the earlier Palaeolithic settlement of Britain, however, either ignores the question altogether or side-steps it by assuming that Britain was joined to the continent, tacitly propagating the view that Britain's geographical status during the Middle Pleistocene is too poorly defined to be of much concern to Palaeolithic archaeology. Yet, as demonstrated in the 1993 *Island Britain* conference (Preece (ed.) 1995), Britain's geographical status was not only transformed on many occasions during the Pleistocene as sea-levels rose and fell in response to major climatic events but a number of these fluctuations can actually be detected in the Quaternary terrestrial record.

For archaeologists, the climatic oscillations and associated ecological changes that occurred during the Middle Pleistocene have always formed the backdrop against which the Palaeolithic occupation of Britain is studied. The large-scale geographical fluctuations that accompanied these, a fundamental element in Quaternary palaeo-environmental change, should be incorporated into this picture. Factoring major palaeogeographical variation into the Pleistocene

[1]Department of Archaeology, University of Durham, South Road, Durham DH1 3LE
[2]Department of Palaeontology, Natural History Museum, Cromwell Road, London SW7 5BD

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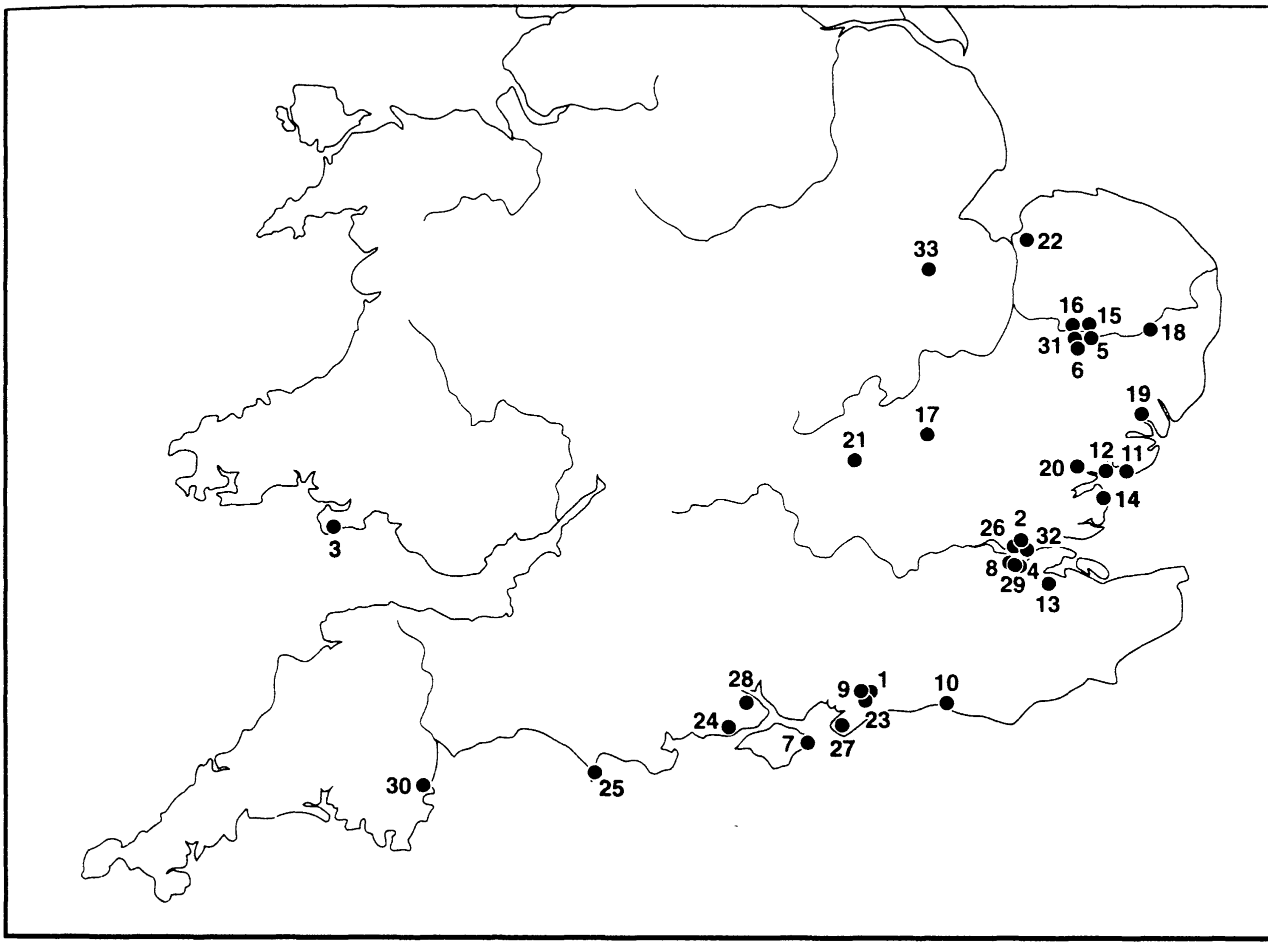
background adds a new dimension to the study of Palaeolithic archaeology in Britain that has particular relevance for understanding the important themes of colonisation, landscape use, settlement history, and culture change in terms of the wider European hominid landscape. Furthermore, the cyclical nature of Pleistocene climatic and environmental fluctuations provides scope for understanding hominid occupation as recurring processes with recognisable mechanisms, both ecologically and socially driven, rather than just as events to be catalogued. This in turn has implications for understanding large-scale variability in the archaeological record, especially the identification of signatures in the lithic record that may be of socio-cultural or adaptive significance.

The recognition and interpretation of large-scale patterning in the archaeological record has hitherto been hindered by the use of a compressed chronostratigraphic framework for the Quaternary. The stratigraphic framework proposed by the Geological Society (Mitchell *et al.* 1973) recognised only two post-Anglian interglacials, the Hoxnian and Ipswichian. More recent evidence from the marine oxygen isotope record (Shackleton 1987) suggests considerably greater climatic complexity, with as many as four temperate episodes identified in the late Middle and Late Pleistocene. The occurrence of four post-Anglian temperate episodes in the British terrestrial sequence has received strong support from terrace stratigraphy (Bridgland 1994; Bridgland *et al.* 1986; 1989; Maddy *et al.* 1991; 1995), amino-stratigraphy (Bowen *et al.* 1989), and mammalian biostratigraphy (Schreve 1997), with partial corroboration coming from molluscan biostratigraphy (Preece 1995). Some of the more complete sequences on the continent, such as Schöningen, Germany (Thieme 1997), also imply the existence of multiple temperate episodes over the last 500 kya, as do long pollen records from western and southern Europe (Tzedakis *et al.* 1997). One critical reference point for the British sequence is the position of the Anglian glaciation, which has generally been correlated with Oxygen Isotope Stage (OIS) 12 (Shackleton & Opdyke 1973; Shackleton 1987; Bowen *et al.* 1986). If this is the case, the four post-Anglian temperate stages indicated in the oxygen isotope record might be equated with OIS 11, 9, 7 and 5e.

This expanded Quaternary chronostratigraphic sequence potentially provides greater accuracy and flexibility in the interpretation of the British Palaeolithic record and is therefore adopted here. This is not to suggest that once everything is in the correct order obvious patterns that are culturally and socially significant will become immediately apparent, but rather that the inability to identify *any* cogent structure that cannot be more parsimoniously attributed to raw materials, function or other proximate adaptive concerns, may be more artificial than real.

This paper outlines the lithological and biological evidence for Britain's fluctuating geographical status during the Middle Pleistocene. These data are used as the basis for constructing a simple heuristic framework in which patterns of human colonisation, settlement and abandonment are coupled with both palaeogeographical and major ecological variation. The principal archaeological implications of this model are outlined and used as a means of interpreting some large-scale patterns in the archaeological record. Contrary to current arguments, the paper suggests that patterns pertaining to distinct traditions of lithic manufacture may actually exist at a recognisable level within the British Palaeolithic record and that these can be accessed and understood as part of the differential ebb and flow of regional populations measured against the backdrop of changing landscapes. It is argued that the Clactonian and Acheulean represent separate pulses of colonisation following a major glaciation: the Clactonian reflecting an early recolonisation event during climatic amelioration, the Acheulean representing a second wave during the main interglacial. This phenomenon is observable during both the Hoxnian and the succeeding interglacial. Moreover, other patterns in the lithic record are argued to reflect specific endemic technological developments during periods of isolation from mainland Europe. The Clactonian is not evident in the later OIS 8–7 climatic amelioration due to the widespread adoption of the Levallois technique prior to this event. Indeed, OIS 8 marks the first regular appearance of Levallois in the British Isles, which may therefore act as an important stratigraphic marker (Wymer 1991; Bridgland 1994; 1996). The sites mentioned or discussed in the text are plotted in figures 1 and 2.



1 Aldingbourne. West Sussex
2 Aveley. Essex
3 Bacon Hole. Gower
4 Baker's Hole. Kent
5 Barnham, Suffolk
6 Beeches Pit. Suffolk
7 Bembridge. Isle of Wight
8 Bowman's Lodge & Wansunt Pit. Dartford, Kent
9 Boxgrove. West Sussex
10 Brighton. East Sussex
11 Clacton, Essex
12 Cudmore Grove, Essex
13 Cuxton. Kent
14 East Hyde. Essex
15 Elveden. Suffolk
16 High Lodge, Suffolk
17 Hitchin. Hertfordshire
18 Hoxne. Suffolk
19 Foxhall Road. Ipswich. Suffolk
20 Marks Tey. Essex
21 Marsworth. Buckinghamshire
22 Nar Valley. Norfolk
23 Norton Farm. West Sussex
24 Pennington. Hampshire
25 Portland Bill. Dorset
26 Purfleet. Essex
27 Selsey. West Sussex
28 Stone Point. Hampshire
29 Swanscombe (Barnfield Pit. Rickson's Pit. Ingress Vale). Ken
30 Torbay. Devon
31 Warren Hill. Suffolk
32 West Thurrock & Little Thurrock. Essex
33 Woodston. Cambridgeshire

Fig. 1
Location map for British sites mentioned in the text

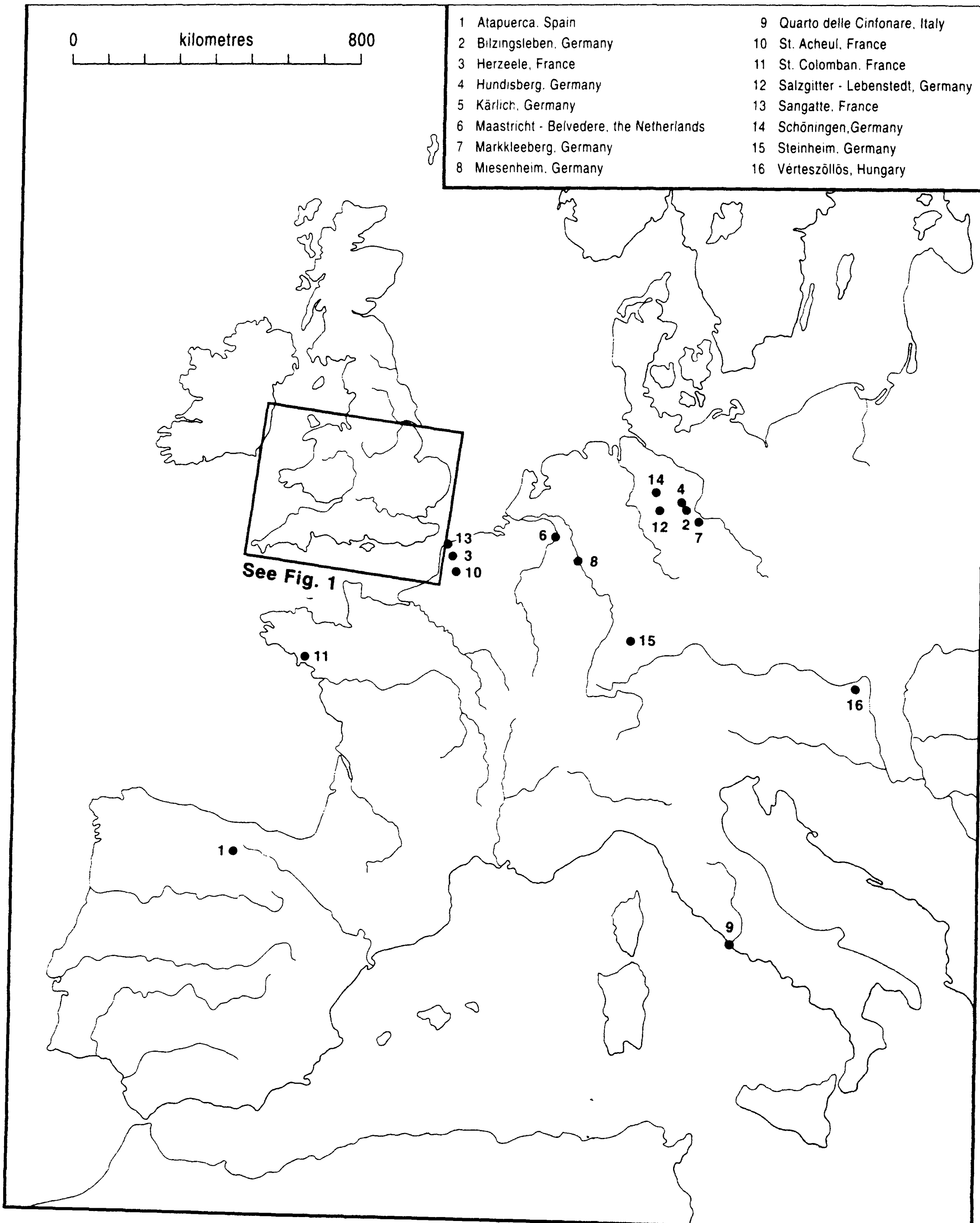


Fig. 2
Location map for main European sites mentioned in the text

A TIMETABLE OF INSULARITY AND PENINSULARITY

Pliocene to early Middle Pleistocene

Funnell (1995) has summarised Britain's status from the Pliocene to early Middle Pleistocene. Various lines of sedimentary and biological evidence indicate that during much of the Pliocene Britain was an island, with very high sea-levels connecting the North Sea to the Atlantic via the English Channel. Early indications of a link to Europe date to the late Pliocene, about 2.5–2.4 Mya, and are associated with global sea-level falls during the first northern hemisphere glaciations (OIS 100, 98, and 96). In probable response to these climatic changes, the major European rivers began to extend their headwaters and increase their bedload transport, leading to progressive deltaic progradation in the southern North Sea basin. This combination of lower sea-levels and progressive sedimentation temporarily converted Britain into a peninsula of the European mainland at about 2.3 Mya. The terminal Pliocene witnessed several marine transgressions and regressions, but by 1.7 Mya the continued expansion of the 'Great European Delta Top' reinforced the land-link, excluding all marine influences from the southern North Sea basin between 1.7–0.5 Mya. Even during periods of high sea-level, Britain seems to have been joined to Europe by this broad connection. By the end of the Cromerian Complex, however, degradation and subsidence of the delta top had already allowed interglacial sea-levels to encroach southwards across it, bounded in the south by the Weald–Artois chalk ridge.

The Middle and Late Pleistocene

During Middle and Late Pleistocene cold episodes, when high global ice volume and associated low sea-levels can be inferred from the marine isotope curve, Britain was almost certainly connected to Europe, not merely as a small peninsula but as part of a broad north-west European land-mass. Supportive evidence comes from several sources:

1. The presence of submerged and infilled valleys in the English Channel indicates sediment deposition during multiple events under a number of different regimes (eg, river-bed, estuarine, and shallow sub-littoral) throughout the course of the Pleistocene (Hamblin & Harrison 1989; Bellamy 1995). These relate to changes in relative sea-level in response to inferred climatic changes – with sub-aerial continental shelf conditions during the cold stages interrupted by interglacial marine submergence. Furthermore, the preservation of sediments representing a series of erstwhile fluvial courses beneath the North Sea demonstrates that terrestrial conditions were periodically the norm in this basin also (Bridgland & D'Olier 1995).
2. Mammalian evidence suggests direct links to the continent during cold stages (Stuart 1995). Although sparse, Pleistocene cold stage faunas in Britain are similar to those from Germany and elsewhere in north-west Europe, as one would expect from a continuous land-mass (*ibid.*). The recovery of Devensian mammalian remains from Pleistocene deposits in the modern North Sea also suggests that this area was periodically dry land (Mol & van Essen 1992; Stuart 1995; Turner 1995; Sutcliffe 1995).

The evidence therefore points to prolonged periods of connection to the European land-mass during the Middle and Late Pleistocene.

If peninsularity is thus assumed to be the 'default state', several conditions must have been required in order for Britain to become temporarily an island during the Middle and Late Pleistocene. These included eustatic sea-level rises (the current limiting depths are above –40 m OD in the North Sea Basin and –50 m OD in the Channel; Keen 1995); progressive downwarping or erosion in the North Sea basin; and, most importantly, the breaching of the Weald–Artois anticlinorium that formed a land-bridge across the Strait of Dover during the early Middle Pleistocene (Gibbard 1995; Keen 1995; Bridgland & D'Olier 1995; Ventris 1996), a factor presumably enhanced by progressive uplift. However, while these factors are pre-requisites to insularity, the situation is far from simple.

While studies of 'reef staircases' in Papua New Guinea (Chappell & Polach 1991) and the Bahamas (Hearty 1998) have demonstrated periods of very high sea-levels during the last 400 kya, this evidence cannot be used simply to assume that Britain was isolated during these periods. Problems associated with long and short term tectonic processes (such as the progressive downwarping of the North-Sea basin, general uplift in response to erosion, glacio-isostatic forebulge, and hydro-isostasy) that would have affected the precise bathymetry of the North Sea and Channel, must be considered when using global sea-level estimates. Thus, the question of whether free circulation of water was possible around Britain, even during the highest sea-level events, must be answered using direct evidence: it cannot be inferred from distant records of global sea-level or from proxies such as the marine isotope curve. Problems also arise from dating and correlating high sea-level events in Britain and between Britain and the rest of the world, which are again greatly affected by tectonic uplift and downwarping. Despite such complications, Keen (1995) has suggested that sea-levels at or above the modern level would have resulted in island status; which implies, hypothetically at least, that Britain should have become isolated from Europe during each interglacial event. Yet, in practice this depended highly on the timing of the final breaching of the Weald–Artois land-bridge.

Breaching the Weald–Artois Chalk Ridge

Present consensus holds that during the Early Pleistocene a land-bridge, formed by the Weald–Artois anticlinorium, existed in the Strait of Dover. The breaching of this land-bridge is argued to have been caused by catastrophic overflow from an ice-dammed lake that occupied the southern North Sea (Roep *et al.* 1975; Smith 1985; 1989), an event which, according to Gibbard (1988; 1995), occurred during the Anglian Glaciation. Evidence for such a lake comes from glacio-lacustrine deposits at several locations on the coast of northern and eastern East Anglia and from thick glacial lake sediments in the North Sea (Ter Wee 1983; Banham 1988; Hart 1992; Lunkka 1994; Gibbard 1995). Evidence for the catastrophic breach is harder to pinpoint, due to the poor preservation of Pleistocene sediments in the Strait of Dover, but some supporting evidence has come from coarse gravels and overlying deposits at the base of a deep channel at Wissant and Wimereux in northern France (Roep *et al.* 1975; Gibbard 1995). These deposits contain occasional northern erratics, as well as Fenno-Scandinavian heavy minerals, both of which support a northern origin.

Many workers accept the evidence that the Weald–Artois ridge was breached during the late Anglian (OIS 12) (Funnell 1995; Bowen *et al.* 1986; Gibbard 1995; Keen 1995; Meijer & Preece 1995). Whether this was immediately sufficient to allow free movement of water between the North Sea and the Atlantic is uncertain (see below), but nevertheless, from the late Anglian onwards the potential existed for Britain to become isolated from Europe, given sufficient sea-level rise during interglacial periods and suitable bathymetry in the Channel, North Sea and Strait of Dover. Current evidence pertaining to the timing and duration of periods of insularity is summarised below.

HOXNIAN – HOLSTEINIAN (OIS 11?)

Despite of the high probability that the Weald–Artois ridge was breached during the Anglian, the stronger evidence shows that Britain was a peninsula for the most part of the succeeding interglacial.

Evidence for peninsularity during the Hoxnian

The Phase II deposits at Swanscombe, Kent (Lower and Upper Middle Gravel) and the Upper Freshwater Beds and Estuarine Beds at Clacton-on-Sea, Essex, record the presence of a distinctive molluscan suite referred to as the 'Rhenish fauna' (Kerney 1971). The 'Rhenish fauna' contains important biostratigraphic indicator species, such as *Theodoxus serratiliformis*, which have also been noted at East Hyde near Tillingham, Essex (Roe & Preece 1995). The presence of this characteristic assemblage in the Lower Thames valley and eastern Essex is widely regarded as indicative of the confluence of the Thames and Rhine river systems at this time (Kennard 1942a; 1942b; Bridgland & D'Olier 1995). At Clacton, the 'Rhenish' suite is found in deposits that have yielded pollen spectra attributed to zone Ho IIIa (Kerney 1971; Turner & Kerney 1971). However, it is clear that elements of this assemblage first appear earlier, albeit rarely; for example, the presence of *T. serratiliformis* and *Pisidium clessini* at the top of the Lower Loam at Swanscombe (terminal Phase I deposits, assigned to pollen sub-zone Ho IIb by Hubbard 1996). Thus there is evidence for a terrestrial link to Europe in the North Sea Basin at least during the period encompassed by pollen zones IIb–IIIa.

Terrestrial molluscan faunas also support a land link, in particular the highly characteristic '*Lyrodiscus*' fauna that has been noted both in British Hoxnian localities, such as Beeches Pit, Suffolk (Kerney 1976; Preece *et al.* 1991) and Hitchin, Hertfordshire (Kerney 1959) and in continental sites attributed to OIS 11 (Rousseau *et al.* 1992).

Additional corroborative evidence for a peninsular Britain during at least part of this period has come from interglacial mammalian faunas, with close correspondence between assemblages from European Holsteinian localities, such as Steinheim (Adam 1954) and Bilzingsleben, Germany (Kahlke & Mania 1994), with British Hoxnian sites (Schreve 1997).

Evidence for insularity during the Hoxnian

During the later part of this interglacial, the land connection was apparently severed. Evidence for a marine transgression starting at the very end of Ho II or beginning of Ho III has been observed at several sites, most notably at Clacton, where implementiferous Freshwater Beds (Ho II–IIIa) at the base of the sequence are overlain by the Estuarine Beds (Ho IIIa–b) that have yielded marine molluscan species (Kennard & Woodward 1923; Warren 1955; Turner & Kerney 1971). Here, the marine transgression occurs at 3 m OD, with estuarine conditions persisting to 9 m OD (Turner & Kerney 1971). At East Hyde, brackish conditions have been inferred from the presence of marine molluscs and ostracods in the same deposits as the Rhenish fauna, possibly suggesting a transitional period from freshwater to marine conditions during zone Ho III (Roe & Preece 1995; Roe 1999). Brackish water Mollusca have also been recorded at *c.* 25 m OD at Dierden's Pit, Ingress Vale (Kerney 1971), in deposits that are the equivalent of the Phase II Middle Gravels at the neighbouring site of Barnfield Pit, Swanscombe. This evidence, together with the presence of a vertebra of bottle-nosed dolphin (*Tursiops truncatus*) (Sutcliffe 1964), which probably became beached after swimming up the estuary, corresponds well with the suggestion that a marine transgression occurred during the mid–late Hoxnian, although the level of recording at this locality precludes a finer correlation. Further corroboration has come from Marks Tey, Essex, where brackish water ostracods have been recovered at 25 m OD, towards the top of this long Hoxnian sequence (Turner 1970; Turner, cited in Ventris 1996).

The age of the marine transgression in the Woodston Beds near Peterborough, Cambridgeshire, is also critical to the understanding of sea-level change during the Hoxnian Interglacial. Mammalian remains from this site have been attributed to OIS 11 (Schreve 1997). The marine incursion in the Woodston Beds begins at *c.* 11 m OD and extends to at least 14.10 m OD but the upper limit of marine conditions is not firmly established due to decalcification and erosion at the top of the sequence. This height range is similar to that at Clacton, although the onset of the transgression at this latter site occurs at a lower level, possibly the result of differential warping between the Wash Embayment and eastern Essex (Meijer & Preece 1995; Roe 1999). Moreover, the onset of the marine transgression at Woodston occurred in sediments attributed to pollen zone Ho IIc (Horton *et al.* 1991), although this correlation is regarded as tentative, since the high non-arboreal pollen phase present in Ho IIc at Marks Tey and Hoxne is not represented at Woodston (*ibid*). However, the difference in facies between the lake sites of Marks Tey and Hoxne and the fluvial/estuarine environment at Woodston may explain this apparent absence at the latter locality. The marine transgression at Woodston therefore seems to have occurred slightly earlier than at Clacton, possibly as a consequence of the more northerly location of the former site and perhaps suggesting the gradual rather than rapid onset of marine conditions around the British coast (see Coles 1998, fig. 10).

Evidence for marine conditions in the Strait of Dover at this time may come from Herzeele, France (Sommé *et al.* 1978), although the dating of this site remains controversial. The Herzeele deposits, which have a base at 8 m NGF, show three marine or tidal deposits separated by peat. These were suggested on the basis of their contained pollen to represent separate marine phases during OIS 13 and 11 (*ibid.*). This interpretation has been questioned by Burger and Meijer (cited in Keen 1995), who suggested that the presence of the 'Rhenish' *T. serratiliformis* at Herzeele indicates that the deposits represent only one temperate stage – the Holsteinian. Attempts to date the deposits using geochemical and radiometric methods have only added to the confusion, providing determinations ranging from OIS 10 to OIS 8 (Miller & Mangerud 1985; Schwarcz & Grün 1988; Bowen & Sykes 1988; Barabbas *et al.* 1988; Balescu & Lamothe 1991; 1993).

Better evidence for marine conditions in the Channel and Strait comes from the Sussex Coastal Plain. Here, evidence for up to five separate high-sea-level events is preserved, possibly corresponding to five separate interglacials (Bates *et al.* 1997). The highest of these, the Goodwood–Slindon Raised Beach, of which the famous implementiferous sediments at Boxgrove are a part (Roberts *et al.*

1997), has been dated to the later part of the Cromerian Complex (Roberts *et al.* 1994; Bates *et al.* 1997) and was thus formed prior to the breaching of the Strait of Dover (although see Bowen & Sykes 1994). The next in the sequence, the Aldingbourne Raised Beach, has an average height of 20 m OD and has been tentatively correlated with the Hoxnian (OIS 11) (Bates *et al.* 1997). These authors further suggest that the higher proportion of non-flint pebbles in the Aldingbourne Raised Beach, in comparison with the Slindon Formation, reflects modifications in the sediments' source areas and transport patterns, which may indicate that the Strait of Dover was open at this time. A third beach level, designated the Cams Down Raised Beach, is argued to represent an altitudinally discrete event (OIS 9?), although it is equally possible that this represents part of the Aldingbourne or Norton–Brighton Raised Beaches (Bates *et al.* 1997; see below).

To summarise, the above evidence demonstrates that during the terminal part of Hoxnian pollen zone II and/or early zone III, a marine transgression severed the connection to continental Europe that had prevailed during the mid-part of the interglacial, thereby isolating Britain from the European mainland. The question remains of Britain's geographical status during the earliest part of this temperate episode. Meijer and Preece (1995) suggested that the absence of southern elements in Hoxnian marine molluscan faunas around the North Sea might indicate that a land barrier still existed between the Channel and the North Sea at this time. Yet, there remain tantalising hints of an marine influence around at least some south-eastern parts of the British coast during this period, such as the presence of marine stenohaline fish in the Lower Loam at Swanscombe (Irving 1996), a smelt tooth and saline tolerant ostracods from the lower part of the sequence at the Clacton Holiday Camp site (Bridgland *et al.* 1999), and the Swanscombe dolphin. Furthermore, if Britain was indeed connected to Europe as part of a broad north-west peninsula during the early Hoxnian, it is unclear why the Rhenish fauna did not make its first appearance until the end of pollen sub-zone Ho IIb. Meijer and Preece (1995) tentatively suggested that this may reflect retarded immigration from distant refugia, although an alternative hypothesis would suggest that Britain experienced a brief period of isolation during the early Hoxnian. Although an early Hoxnian period of insularity remains hypothetical and highly speculative, it has been suggested that glacio-isostatic depression of the crust of north-west Europe, persisting after the very extensive OIS 12 glaciation, could have led to a penetrative Holsteinian/Hoxnian transgression, the sea flooding in before the crust could recover (Kukla & Cilek 1996). If this was sufficient to disconnect Britain from mainland Europe, later crustal uplift would then have reconnected Britain to continental Europe sometime during Ho II, thereby allowing the incursion of the Rhenish Suite. The evidence is minimal, although the issue is far from resolved either way.

THE PURFLEET INTERGLACIAL (OIS 9?)

Evidence for island status during the unnamed interglacial correlated with OIS 9, represented at Purfleet and Grays Thurrock in the Lower Thames (Bridgland 1994), is extremely sparse, mainly reflecting the small number of sites that have thus far been attributed to this warm stage. The best evidence available comes from the east Essex coast, the second terrace of the Lower Thames valley, the Sussex Coastal Plain and the Wash embayment in Britain, and perhaps also the Sangatte Raised Beach and Herzeele (see above) in northern France.

At Cudmore Grove, Essex, a channel fill sequence records a transition from freshwater to marine conditions. The marine transgression occurs at a height of between –8 m and –1 m OD during pollen zone II of an interglacial, clearly contrasting with the record from Clacton where brackish conditions first appear at approximately 3 m OD in zone III of the interglacial. Although Roe (1995; 1999) concluded that both sites might date to the Hoxnian interglacial, representing different parts of a complex estuarine system, Schreve (1997) has argued, on the basis of mammalian biostratigraphy, that Cudmore Grove and Clacton in fact date from two separate interglacials (cf Bridgland 1995). According to Schreve (1997), critical elements of the Hoxnian mammalian fauna are absent from Cudmore Grove. However, several other important indicator species are present, permitting correlation of Cudmore Grove with sites on the middle terrace of the Lower Thames (Corbets Tey Gravel Formation), such as Purfleet and Grays Thurrock, attributed to OIS 9 (Bridgland 1994; Schreve 1997).

At the site of Greenlands Pit, Purfleet, evidence of marine conditions is more equivocal. Here, a laminated grey silty clay, lying at 14 m OD, was originally attributed to deposition in an intertidal environment (Hollin 1977). However, recent resampling of this unit failed to recover any evidence which might confirm a strong marine influence at this time (Schreve 1997; Schreve *et al.* in prep). The clay is overlain by a shelly-sand that contains extremely well preserved freshwater Mollusca along with abundant vertebrate remains and occasional artefacts. Ostracods are also present in the shell-bed, including the brackish-water indicator *Cyprideis torosa*. However, the extremely noded morphotype of this species indicates that at this time the Purfleet site lay right at the limit of tidal influence (Schreve *et al.* in prep). The evidence for marine conditions during the interglacial represented at Purfleet is therefore muted, although this is probably a reflection of the distance of the site from the contemporary coastline. Furthermore, owing to the absence of polleniferous sediments at the site, it is not possible to attribute the evidence of marine influence (however limited) to a particular pollen zone. Hollin (1977) reported similar laminated deposits, which he also attributed to tidal estuarine conditions, at Globe Pit, Little Thurrock (see below).

The valley of the Nar, a river flowing from north Norfolk into the Wash embayment, has also yielded evidence of high sea-levels (Ventris 1986; 1996; West 1987). Here, palynological evidence suggests the onset of marine conditions during sub-zone IIc of an interglacial, beginning at a height of 2.5 m OD and reaching a maximum level of *c.* 23 m OD in zone III (Ventris 1996). Correlation of the Nar Valley sediments with the Hoxnian site of Woodston (see above) has previously been proposed (Horton *et al.* 1992), although this implies a 10 m difference in the height of the marine transgression from the north side of the Wash to the south. Several explanations have been put forward for these differences by Horton *et al.* (*ibid.*), for example differential warping, but the possibility remains that the two localities may not in fact be contemporary. This latter hypothesis is supported by Uranium Series dates of 317±14 kya, suggesting correlation of the Nar Valley interglacial deposits with OIS 9 (Rowe *et al.* 1997).

The Sangatte Raised Beach, on the French side of the Strait of Dover, lies at a height of 8–10 m NGF. Regional stratigraphical correlations have suggested an OIS 7 attribution (Balescu & Haesaerts 1984), as have TL dates (Balescu *et al.* 1992) and aminostratigraphy (Bates 1993). Antoine (1989), on the other hand, supported an OIS 9 date, based on the occurrence of palaeosols believed to be of OIS 7 and 5e age above the marine horizon. The deposits at Herzeele (see above) have also been attributed to OIS 9 by some authors, while the Cams Down Raised Beach on the Sussex Coastal Plain has very tentatively been correlated with this interglacial (Bates *et al.* 1997).

Clear evidence for insularity during the unnamed interglacial correlated with OIS 9 is restricted by the lack of good sites unequivocally dated to this period. The evidence from Cudmore Grove and the Nar Valley indicates that high sea-levels did encroach around the East Anglian coast for part of the interglacial, while the sites in France and the Sussex Coastal Plain, if really of the same age, also show marine conditions prevailed in the Channel and Strait. It is probable that Britain did become isolated for at least part of this interglacial, beginning in pollen zone II, although this issue requires much further work.

AVELEY (PENULTIMATE) INTERGLACIAL (OIS 7)

The evidence for insularity during the penultimate interglacial is considerably greater and more cogent than for earlier periods, with a number of sites in the Lower Thames basin and on the south coast of England.

In the Lower Thames valley, deposits within the Mucking Gravel Formation have been put forward as providing evidence of high sea-levels during this period. At Aveley, Essex, brackish-water molluscs and ostracods have been noted in the Lower Brickearth (T. Allen & J.E. Robinson, cited in Sutcliffe 1995; Cooper 1972; Holyoak 1983), suggesting that high sea-levels prevailed during the early part of this interglacial. Fine-grained laminated sediments, attributed to a later part of the same interglacial (Schreve 1997) at the Lion Pit Tramway Cutting, West Thurrock, Essex, have also been interpreted as reflecting intertidal or estuarine conditions (Hollin 1977).

Further evidence of marine conditions during the penultimate interglacial has come from the extensive Norton–Brighton Raised Beach on the Sussex Coastal Plain (Bates *et al.* 1997; Bates 1998). Deposits at Black Rock, Brighton, situated at a base height of 8.5m OD, have yielded age-estimates based upon aminostratigraphy (AAR), which suggest correlation with OIS 7 (Davies 1984). This is supported by a mammalian assemblage from the Coombe Rock deposits overlying the Brighton raised beach, which shows clear affinities with others recovered from cold-climate deposits immediately pre-dating Last Interglacial sediments at Bacon Hole, Gower (Stringer *et al.* 1986) and Marsworth, Buckinghamshire (Murton *et al.* in prep.). AAR, again combined with mammalian biostratigraphy, have yielded similar age estimates for the deposits at Norton Farm (Bates 1998).

Raised beach deposits at Portland Bill, Dorset (Davies & Keen 1985) have also been correlated with OIS 7 based on AAR, while Uranium Series dates of 210+34/-76 kya and 226+53/-76 kya (Proctor & Smart 1991), together with AAR (Mottershead *et al.* 1987), have suggested a similar correlation for sea cave deposits at Berry Head, Torbay, Devon.

Other probable sites of this age showing marine/brackish conditions occur at Selsey, West Sussex, where freshwater organic muds lying on or just below OD are overlain by estuarine clays. A brackish influence, associated with a marine transgression and later regression, is first detected at -1.76 m OD (West & Sparks 1960), followed by marine conditions, under which 2–3 m of raised beach gravel were deposited, reaching a height of 7.5 m OD. The whole sequence is capped by brickearth. The mammalian biostratigraphic evidence (Sutcliffe 1995) and AARs (Bates *et al.* 1997), in addition to the overall similarity in the height of the temperate climate deposits at Selsey to those at Black Rock and Stone Point (below), strongly suggest that the Selsey sequence pre-dates the Ipswichian Interglacial (*contra* West & Sparks 1960). The Selsey interglacial deposits most probably relate to a temperate episode correlated with OIS 7.

At the aforementioned site of Stone Point, Hampshire, West and Sparks (1960) and Brown *et al.* (1975) recorded the presence of fossiliferous interbedded freshwater peats overlain by clays, extending up to 2 m OD, containing Mollusca characteristic of brackish intertidal conditions in an estuarine environment (West & Sparks 1960; Brown *et al.* 1975). Examination of brickearth deposits which overlie a terrace gravel capping these brackish muds has revealed the presence of a palaeosol of interglacial type, suggested by Reynolds (1987) to have been formed during the Ipswichian. If this is correct, the underlying fossiliferous muds at Stone Point must be of OIS 7 age or older (Allen *et al.* 1996; Keen 1995). A pre-Ipswichian age is further supported by comparison of the Stone Point sequence with that from Pennington, Hampshire, also within the Solent River terrace system. Here, pollen and freshwater Mollusca, attributed to the Ipswichian (Sub-stage 5e), occur between -3.9 m and -5.3 m OD, in a separate, lower terrace (Allen *et al.* 1996). The difference in height and relative position of the Stone Point and Pennington sequences within the Solent River terrace staircase strongly implies that they belong to separate interglacials, with Stone Point being the older.

However, the mammalian evidence from Stone Point is rather different to that recovered from nearby Selsey, in that *Dama dama* (a species unknown in the late OIS 7 'mammoth-horse' faunal suite) is present. A possible explanation for this is that the Stone Point temperate climate deposits relate to an earlier, more densely-wooded part of the OIS 7 interglacial than Selsey, similar to that seen in the basal part of the sequence at Aveley. That the Stone Point organic deposits may be slightly older than those at Selsey is also hinted at by the lower elevation of the latter organic deposits, which lie on or just below OD (West & Sparks 1960). This would be consistent with a small separation in time, although still within the same interglacial.

Examination of the isotope curve reveals that OIS 7 contains several significant climatic oscillations, consisting of at least two temperate peaks, separated by shorter periods of colder conditions. Schreve (1997) suggested that there is evidence for isolation during the earlier part of the interglacial (brackish molluscs at Stone Point; brackish molluscs and ostracods in the Lower Brickearth at Aveley), followed by reconnection to the European mainland. This is based on a dramatic mammalian faunal turnover midway through the interglacial, indicated by a transition from a woodland-dominated fauna to a predominantly open steppe-grassland (but equally temperate) fauna. Only an intervening period of cooler conditions, permitting a lowering of sea-level and reconnection to the continent, could allow the mass immigration of species such as the mammoth and other elements of the steppe-grassland fauna. In this regard, the evidence from Norton Farm (Bates 1998) and Tancarville, northern France (Lefebvre 1993) of high sea-levels associated with cool climatic conditions becomes increasingly intriguing. Following reconnection, it seems likely that a further period of high sea-level occurred (as witnessed, for example, by the raised beach at Selsey, and laminated sediments at West Thurrock (Hollin 1977; Bridgland & Harding 1993)).

In general, there is good geological evidence that Britain was an island for much of the penultimate interglacial. Although there is no direct evidence pertaining to conditions in the Strait of Dover, marine environments are indicated in both the Eastern Channel and southern North Sea. Assuming the Strait of Dover was open at this time, it is fair to suggest that isolation was achieved; possibly more than once if the recent mammalian findings are correct.

AN HEURISTIC FRAMEWORK FOR THE HUMAN SETTLEMENT OF BRITAIN

The data presented above synthesises the evidence for Britain's fluctuating geographical status during the late Middle Pleistocene (Table 1). This demonstrates that terrestrial links with mainland Europe were alternately established and broken as sea-levels rose and fell in response to major global climatic change, cyclically converting Britain from a peninsula to an island, and back again. The evidence for insularity becomes weaker with increased temporal distance, raising the question of whether this is a real phenomenon or a problem of time-depth, preservation or resolution. Indeed, evidence for island status is strongest during the Last Interglacial (Ipswichian/OIS 5e: see papers in Preece 1995), although as humans were apparently absent from Britain during this period (Currant 1986; Wymer 1988; Currant & Jacobi 1997; Ashton n.d.) it is not discussed in this paper. On the scale of the Middle Pleistocene, periods of insularity appear to have been relatively short compared to periods of peninsularity. However, this insularity actually spans extensive periods of real time, even more so on the time scales familiar to the contemporary human occupants.

While palaeogeography, together with the more familiar climatic and ecological changes, provides a broad Pleistocene canvas against which to study the British Lower Palaeolithic, on their own they only provide a broken timetable of events and conditions on geological time-scales. A framework aimed at broadly modelling hominid responses to and relationships with these factors is required before we can begin to use the geological evidence to investigate and interpret the archaeological record. Concentrating on ecological relationships, this section outlines a biogeographical model that factors a simple tripartite sequence of human colonisation, occupation and abandonment against prevailing palaeogeographical and climatic conditions. We fully accept that individual sequences may actually be more complex than currently recognised. However, it is offered as a *generalised* and *speculative* model from which specific cases and more localised conditions can later be developed (Fig. 3).

Phase One: Cold Stage Peninsula – residency and abandonment

The high global ice volume and low sea-level inferred for each glacial episode led to Britain being joined to mainland Europe during these periods. This would have provided the *potential* for unrestricted movement of human (and animal) populations between these two land-masses, while also opening up areas of the North Sea and Channel basins for potential human settlement. The precise patterns of settlement and movement are expected to have varied throughout the course of a glacial episode.

- During the early glacial period, cool but 'intermediate' environmental conditions (cf Gamble 1986; Roebroeks *et al.* 1992a) are expected to have provided suitable mosaic habitats for sustained human settlement within areas of Britain, the North Sea basin and the Channel basin. The potential for free movement by both humans and animals across these basins also existed, hindered only by the presence of local barriers such as large rivers, lakes, deltas, and other human populations (the latter depending upon social organisation, territoriality, mobility strategies, population density, and interaction between different hominid groups).

  As conditions deteriorated and ice volume increased towards the glacial maximum, parts of the North Sea basin would have become blocked by advancing ice and ice-related phenomena, reducing the potential for movement and habitation. Worsening conditions on the British landmass would also have pushed human and animal populations further south and south-east.
- During the glacial maximum, with ice covering northern and, on occasion, parts of midland and southern Britain, totally inhospitable climatic and environmental conditions are presumed to have prevailed (periglacial fronts, polar desert and arctic tundra with a (seasonal) dearth of floral and faunal resources, etc; see summary and references in Jones & Keen, 1993; Gamble 1986). We infer that these conditions represented a climatic threshold, beyond the coping range of the cultural and physical adaptations and social organisation of Middle

TABLE 1: SUMMARY OF BRITAIN'S GEOGRAPHICAL STATUS AND ARCHAEOLOGICAL RECORD FOR THE MIDDLE PLEISTOCENE

Period	*Geographical status*	*Archaeology*
OIS 7 (Aveley) Interglacial	Island Status prevailed during both early and late interglacial Short period of connection to Europe inferred from faunal turnover mid-way through interglacial	Levallois assemblages
OIS 8 Glacial	Inferred peninsularity during majority of glaciation	Introduction of Levallois technique towards end glacial Inferred abandonment during glacial maximum Acheulean assemblages in early OIS 8 deposits
OIS 9 (Purfleet) Interglacial	Marine transgression of unknown duration beginning in pollen zone II. Assumed peninsularity earlier, with possible reconnection later in interglacial	Sequence shows only non-handaxe assemblages early in the interglacial, with later appearance of Acheulean assemblages
OIS 10 Glacial	Inferred peninsularity during majority of glaciation	Non-handaxe assemblages in terminal OIS 10 deposits Abandonment during glacial maximum Acheulean in early OIS 10 deposits
Late Hoxnian	Island with marine transgression starting in northerly locations in Ho IIc. ?Separation complete by IIIb	Acheulean only — many assemblages with twisted ovates
Mid-Hoxnian	Peninsula from at least pollen sub-Zone Ho IIb until early III	Clactonian exclusively present until IIb, then Acheulean only from (?)IIc onwards
Early Hoxnian	Status uncertain. Peninsula initially to allow human colonisation	Clactonian only
Early Pleistocene to end of Anglian glaciation	Peninsula	Non-handaxe assemblages in terminal Anglian Inferred abandonment during glacial maximum Acheulean assemblages within Cromerian complex

Pleistocene hominids (just as the Last Glacial Maximum in north-west Europe seems to have been for modern humans). This is expected to have caused depopulation of most areas of Britain through local extinction or migration to southerly refugia, with complete abandonment during the extreme glacial maxima (cf Roe 1981; Gamble 1986; Roebroeks *et al.* 1992a and comments therein; Housley *et al.* 1997; Roe 1996; Rowley-Conwy 1999; Gamble & Roebroeks 1999). Indeed, Klein (1999) detects a total absence of extreme glacial occupation from most or all of north-west Europe prior to OIS 8. Even if partly caused by the destructive power of the ambient environment or later ice sheets, such factors do not explain the apparent absence of early Middle Pleistocene human occupation in extreme glacial deposits in northern France, an area never covered by ice sheets during the Pleistocene.

The familiar temperate faunas also disappeared during these cold phases, eventually being replaced by cold steppic or tundra species such as reindeer. Even these species may have disappeared during the most severe glacial phases, howere (see Swainton 1999).

Phase Two: Late Glacial/Early Interglacial Peninsula – human colonisation and residency

Gradually, as the glacial ice sheets retreated northwards, Britain once again became a viable habitat for human colonisation and settlement. Continuing low sea-levels during the initial part of this period maintained terrestrial conditions in parts of the North Sea and English Channel, providing habitable landscapes and allowing potentially unrestricted movement between Britain and Europe, excepting local barriers. Accepting the premise of depopulation at the height of the previous cold stage, initial recolonisation of the empty British landscape by temperate mammalian faunas and humans would have taken place at this time. Although post-glacial warming may have been remarkably swift, a time-lag is expected before re-colonisation occurred to allow for the recovery of the previously (peri-)glaciated landscape, making possible the re-establishment of plant communities capable of supporting herbivorous mammals, which in turn could support various carnivores, including humans. Re-colonisation could have potentially occurred all along the southern and eastern coastlines, depending on the location of suitable founder populations on mainland Europe, the presence of local barriers to movement, and on the precise mechanism of human colonisation. However, stochastically rising sea-levels during the course of this period would have acted to reduce progressively the extent of the terrestrial areas, gradually restricting both movement and settlement opportunities.

Within this phase, more precise human settlement patterns and population dynamics are expected to relate to the structure of the local and regional environment. These pertain to smaller scale settlement patterns and are thus not factored into the current model. Important variables to consider, though, include the structure of the mosaic environment, the distribution of preferred habitats and mobility patterns.

Phase Three: Interglacial Island – residency and isolation

At various times during successive post-Anglian interglacials, Britain became an island. Assuming that hominids did not possess boatcraft (*contra* Morwood *et al.* 1998), and that the flooded Channel and North Sea basins represented adequate barriers to colonisation, Britain was isolated from the rest of Europe at these times. For hominid populations already in Britain, access to the main European cultural and genetic pools was consequently severed until the next fall in sea-level. In other words, existing

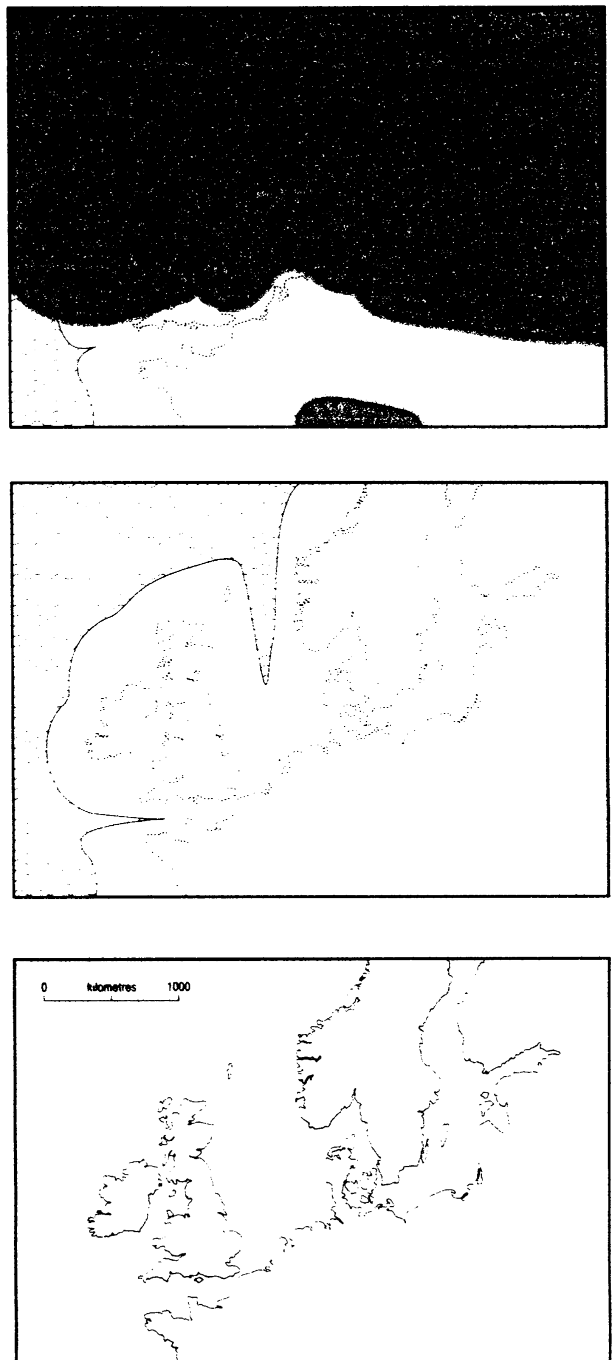


Fig. 3
Tripartite sequence schematically illustrating Britain's geographical status during a generalised climatic cycle a) Phase 1: maximum glacial peninsula; b) Phase 2: final glacial/ early interglacial peninsula; c) Phase 3: interglacial island. All three phases will grade one into the other depending on ice volume and sea-level. Illustrations shown detail extreme situations only

populations became isolated on island Britain. Settlement patterns and population dynamics during this phase depended highly on the structure of the mosaic environment and human social organisation. The end of this phase would be marked by renewed colder conditions, gradually causing sea-level to fall and returning Britain to a peninsula (return to phase 1).

The timing and duration of these phases is expected to have been variable throughout the Pleistocene. Although the Last Glacial–Holocene demonstrates only a single, gradual marine transgression, over the course of the earlier interglacials, insularity and peninsularity may have fluctuated within a single climatic episode, depending on basin bathymetry, sea-levels, and global ice developments. Such fluctuations may reflect minor oscillations within a particular climatic episode, possibly corresponding to sub-stages of the marine isotope record. For example, during the cold sub-stages evident within interglacials, some of which were almost of full glacial severity, sea-level may have fallen, populations may have ebbed and flowed, and some areas may have experienced temporary abandonment and recolonisation. The above framework breaks a seamless climatic cycle into three broad segments with full acknowledgement of the potential for considerably more complexity (see for example OIS 7). To summarise the main point: while continuous occupation could potentially have occurred throughout an entire late glacial–interglacial–early glacial cycle, with Britain in a variety of palaeogeographical and environmental states, it is proposed that the glacial maxima witnessed an environmental threshold that caused the complete human abandonment of the British landmass. Therefore, each glacial maximum and subsequent recolonisation event would have witnessed a complete population turnover.

ARCHAEOLOGICAL IMPLICATIONS

1. Most obviously, Britain was not continuously occupied from the late Cromerian Complex onwards. Rather, population ebbed and flowed, with both predictable and unpredictable local extinction and/or total abandonment. The archaeological record for Britain is thus a stochastic register of colonisation, settlement, and depopulation, with no persistent cultural signature.
2. The evidence of an almost continuous link to the continent prior to the Anglian glaciation implies that the apparent absence of humans from Britain prior to the late Cromerian Complex is not due to geographical barriers but reflects the real absence of humans from north-west Europe at this time (eg, Roebroeks & van Kolfschoten 1994; 1995).
3. Colonisation events (or recolonisation following abandonment) may provide an explanation for some of the industrial variation evident within the British Palaeolithic record. If colonised by different regional populations with contrasting lithic repertoires, then we may be justified in seeking European precedents or analogues for the lithic signatures found in Britain during interglacials. Alternatively, the process of colonisation itself may have affected the social organisation and channels of cultural transmission of some dispersing populations, producing concomitant changes in their material culture (cf, Mithen 1994; Aldhouse Green 1998; Toth & Schick 1993).
4. When isolated from the rest of Europe, hominids in Britain would have been cut off from the main European genetic and cultural pools. While mainland Britain apparently did not witness the development of endemic biological forms or communities (for example dwarfing/gigantism, cf Lister 1995), the possibility still existed for insular development in the rapidly transmitted, non-biological realm of material culture. The socially transmitted lithic technologies used in island Britain, an essentially closed and geographically bounded system, might therefore have developed along idiosyncratic lines different to those evident in neighbouring parts of Europe, leading to endemic technical practices or traditions (cf, for various mechanisms, see Mithen, 1994; Issac, 1972; Boyd & Richerson 1985; Steele & Shennan 1996). These may be manifest and identifiable in the archaeological record as specific regional or sub-regional technological and typological signatures. Similarly, any changes that occurred in Europe at these times would not have reached Britain until contact was re-established (and vice versa; cf Roe 1981).

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While some of these points may be relevant to Europe in general, especially when viewed at various regional and temporal scales and given assumptions of very low population densities, it is far easier to assess such factors when dealing with an island or a frequently abandoned peninsula than with inferred social or geographic isolation on a large continent (see Rolland 1998). Possible examples of how the Island Britain model may contribute to the interpretation of the British Palaeolithic record are presented below.

THE CLACTONIAN AND THE ISLAND BRITAIN MODEL

The Clactonian (Warren 1922; 1951; Breuil 1932) is the archetypal core and flake industry for north-west Europe. It is traditionally defined by the absence of handaxes and by the use of a primitive mode of core technology producing unstandardised, voluminous cores and thick wide flakes with high flaking angles, prominent bulbs, and large unfaceted platforms (Chandler 1930; Breuil 1932; Oakley & Leakey 1937; Warren 1951; Wymer 1968). The classic interpretation of the Clactonian maintains that it represents a distinct non-handaxe making tradition, with little relationship to the Acheulean but with close affinities to the chopper-tool complexes of eastern Europe and Asia (Oakley 1949; Warren 1951; Wymer 1968). It has also been widely suggested that the Clactonian represents the earliest occupation of Britain, produced by non-handaxe making pioneers who entered Britain during the late Anglian, about 400 kyr (Wymer 1968; 1974). Over the past 20 years, the various tenets of this interpretation have been gradually undermined and refuted.

The notion that the Clactonian represents the earliest occupation of Britain (Oakley 1961; Wymer 1968; 1974) has been conclusively disproved by the evidence for much older, pre-Anglian handaxe assemblages from sites such as Boxgrove, Sussex (Roberts 1986), High Lodge, Suffolk (Ashton *et al.* 1992), and Warren Hill, Suffolk (Wymer *et al.* 1991). Furthermore, new research on a large number of Clactonian and Acheulean assemblages has shown that the types of core and flake working previously believed to be diagnostic markers of the Clactonian were also an integral part of the technological repertoire of the Acheulean (McNabb 1992; Ashton *et al.* 1994a; 1994b; McNabb & Ashton 1995; cf Newcomer 1971). Claims have also been made for the presence of handaxes in the Clactonian, but almost all of these are from questionable contexts and represent atypical or 'non-classic' examples that exhibit bifacial working of a convenient edge but which show little attempt to impose a pre-conceived form, as implied by the traditional concept of a handaxe (Ashton & McNabb 1994; McNabb & Ashton 1992; McNabb 1996a; Conway, 1996). Some modern workers view these as grounds on which to reject the notion of the Clactonian being separate from the Acheulean (Ashton & McNabb 1994; Roberts *et al.* 1995; McNabb 1996a; 1996b).

While a full exegesis of the techno-typological and interpretative intricacies of the recent Clactonian debate is outside the scope of this paper, a short discussion is still required. Fuller accounts can be found in White (2000) and Wenban-Smith (1998) both of whom concluded that, contrary to recent claims, there are still reasons to support the existence of a distinctive non-handaxe variant in the British Lower Palaeolithic. Merely accepting that the Clactonian exhibits a basic absence of classic handaxes – a situation encountered in numerous European sites – demands an explanation. Many alternatives to the classic cultural argument for the presence/absence of handaxes have been offered during the past 30 years, including: differences in ecological preference and subsistence (Collins 1969); activity facies (McNabb 1992); raw material potential (McNabb 1992); differences in the mechanics of social learning due to ecological and demographic factors (Mithen 1994; 1996); a shift from expedient to planned behaviour over the course of interglacials in response to changing raw material availability (Wenban-Smith 1998); differential landscape use according to local or immediate circumstances (Ashton 1998); and the enactment of different elements in the *chaîne opératoire* in different places, producing a handaxe (thinning, finishing, and use) and non-handaxe (roughing out) signature (Ohel 1979). While at face value many of these offer sound explanations, none is without its difficulties (see White 2000 for a full review).

The various techno-functional interpretations that see the Clactonian as an atypical variant of an elastic Acheulean (Rolland 1998) are not well supported by the data. The notion of different activity facies is difficult to sustain, especially given the nature of the data and also the similarities in both the microscopic and macroscopic evidence for the tasks conducted at these sites (compare, for example, the use-wear patterns and cut-marked animal bones from Swanscombe Phase I deposits and Clacton with those at Hoxne and Boxgrove (Keeley 1980; 1993; Mitchell 1996; Binford 1985, Pitts & Roberts 1997; Simon Parfitt, pers. comm. 1999)). Similarly, the character of the local lithic resources does not provide a full explanation for the absence of handaxes; the raw materials exploited in Clactonian contexts are quantitatively and qualitatively similar to those used in the Acheulean and quite adequate for handaxe manufacture. Moreover, at other sites where raw materials suitable for handaxe manufacture were lacking, better materials were introduced from elsewhere (eg, Hoxne Lower Industry; Wymer & Singer 1993) or an alternative material was used (eg, bone handaxes from raw material-poor locations in Italy such as Castel di Guido; Radmilli 1984). The proximate ecological setting evident for most Clactonian contexts – river banks and open flood-plains flanked by temperate mixed-open woodland – is also true for most Acheulean occurrences, suggesting that local environmental conditions, measured on the gross scale of Middle Pleistocene environmental reconstruction, played little direct part. Furthermore, the temporal distribution of the Clactonian (Table 2), as currently understood, not only suggests that any explanation assuming contemporaneity between the Clactonian and Acheulean (eg, Ohel 1979) is inapplicable but also provides scope for exploring another, more familiar avenue: that the Clactonian represents the product of a discreet, habitually non-handaxe making population.

On current evidence *unmixed* Clactonian assemblages have been found in five contexts: the Clacton Channel(s), the Lower Gravels at Swanscombe (Rickson's Pit and the Barnfield Pit), the Lower Loam at Swanscombe (Barnfield Pit), Globe Pit, Little Thurrock (Bed 1) and the Lower Gravels at Purfleet (Wymer, 1968; 1985). A further example may be present at Cuxton, Kent where Cruse (1987) described a sequence of fluviatile sands and coarse gravels of the River Medway containing two archaeological series, separated by a depositional hiatus. The upper series was an Acheulean assemblage with abundant handaxes, but the lower assemblage

TABLE 2: CHRONOLOGY OF CLACTONIAN SITES

Site	*Age*	*Evidence*	*References*
Globe Pit Little Thurrock	late OIS 10/ early OIS 9	• Basal part of Lynch Hill/ Corbets Tey Formation • At Grays Thurrock the lateral equivalent of the Globe Pit brickearths yielded a pre-OIS 7/post-Hoxnian fauna (OIS 9)	Bridgland & Harding 1993; Bridgland 1994; Schreve 1997
Cuxton	late OIS 10/ early OIS 9	• Basal part of Lynch Hill/Corbets Tey Formation	Bridgland 1996 & pers. comm.
Purfleet	late OIS 10/ early OIS 9	• Basal Gravels of Lynch Hill/Corbets Tey Formation • Overlying interglacial deposits yielded a pre-OIS 7/ post-Hoxnian (i.e. OIS 9) faunal suite	Bridgland 1994; Schreve 1997; Schreve *et al.* in press
Clacton Freshwater Bed	early Hoxnian (OIS 11)	• Lower Part of Boyn Hill/Orsett Heath Formation • Early Hoxnian mammal fauna • Non-Rhenish mollusc fauna • Early Hoxnian pollen profile	Turner & Kerney 1971; Wymer 1974, 1985; Bridgland 1994; Schreve 1997
Swanscombe, Phase I deposits	early Hoxnian (OIS 11)	• Lower Part of Boyn Hill/Orsett Heath Formation • Early Hoxnian mammal fauna • Non-Rhenish mollusc fauna	Bridgland 1994; Schreve 1997; Kerney 1971; Conway *et al.* 1996
Barnham (rolled series)	early Hoxnian (OIS 11)	• Conformably overlies Anglian till • Early Hoxnian fauna found in related deposits, although precise relationship unclear	Ashton *et al.* 1998

was completely lacking in handaxes (Callow in Cruse 1987). Despite previous suggestions that the artefacts were reworked into Devensian gravels (Bridgland in Cruse 1987), making the apparent succession dubious, it now appears likely that they represent primary context assemblages within the Medway equivalent of the Corbets Tey Gravel Formation of the River Thames (Bridgland 1996 & pers. comm. 1999). The rolled material from within and below the cobble layer at Barnham St Gregory probably provides another genuine example, although the fresh *in situ* material from the same site is now known to contain a significant handaxe element and must therefore be considered Acheulean (Ashton *et al.* 1998.). While this is a small number of sites, many other Clactonian occurrences have been claimed, mostly mixed with Acheulean material (e.g. Highland's Farm, Oxfordshire; Wymer, 1961, 1968). However, as recent technological work has shown (McNabb 1992), it is impossible to objectively separate Acheulean and Clactonian core-and-flake working should they become mixed in even remotely similar condition. Moreover, while the presence of a single handaxe or group of thinning flakes will automatically warrant an Acheulean designation, few would regard a site as Clactonian based on a small collection of hard-hammer flakes and cores. Thus, taphonomy combined with archaeological systematics act to make the recognition of Clactonian assemblages extremely difficult and lead to an artificially high number of Acheulean assemblages. The current corpus probably represents those few fortuitous discoveries where later mixing did not occur. The small sample size should not be taken as a priori evidence that the Clactonian does not exist (White 2000).

With regards to the ages of these sites, the Swanscombe Clactonian assemblages are found in the Lower Gravel and Lower Loam, deposits forming part of the Boyn Hill/Orsett Heath Gravel Formation, correlated with the early Hoxnian (OIS 11), Ho IIb and before. The overlying deposits, all dating to later parts of the Hoxnian (Kerney 1971; Bridgland 1994; Schreve 1997), contain Acheulean assemblages with abundant handaxes. Non-handaxe assemblages from the type site at Clacton have come from a number of contexts, although the vast majority have been recovered from the lower Freshwater Beds (Wymer 1985; Bridgland 1994; Bridgland *et al.* 1999). These deposits also form part of the downstream equivalent of the Boyn Hill/Orsett Heath Gravel Formation and can be closely correlated with the Lower Gravel and Lower Loam at Swanscombe on the basis of molluscan (Turner & Kerney 1971; Kerney 1971) and mammalian faunas (Schreve 1997). Consequently, these two key Clactonian sites are contemporaneous and occur along the same river. A case can be made for also placing the Barnham rolled series in this time bracket (White 1999; 2000; Ashton *et al.* 1998). Therefore, based on cross-correlation of molluscan, palynological, and faunal evidence, Clactonian industries were produced in Hoxnian Britain only during the earlier phases of that interglacial, possibly from the terminal Anglian up to and including Ho IIb (Wymer 1974; 1988; Schreve 1997). Within the state of current knowledge, no Acheulean assemblage from the Hoxnian interglacial can be firmly correlated with any period prior to the very end of the early temperate zone, during or following pollen sub-zone Ho IIc (Wymer 1974; 1988). At Swanscombe and probably Barnham, Acheulean assemblages are stratified above Clactonian ones, but the reverse has never been encountered at any British site.

The assemblages from the Purfleet lower gravel and Globe Pit, Bed 1, can also be correlated, both belonging to the Little Thurrock member of the Lynch Hill/Corbets Tey Gravel Formation of the Thames, equated with terminal OIS 10–early OIS 9 (Bridgland & Harding 1993; Bridgland 1994; Schreve *et al.* in prep). Differential pollen and molluscan preservation from these fluvial sites precludes a finer correlation. The site at Cuxton, located within the Medway equivalent of the Corbets Tey Formation and showing a non-handaxe assemblage underlying an Acheulean one, fits well with this temporal distribution. In general, the sequence of early non-handaxe assemblages giving way to handaxe industries later in the climatic cycle at these sites closely parallels the pattern documented for the Hoxnian sites. Furthermore, at both Purfleet and Cuxton, early Levallois elements have been recorded from towards the top of the sequences (Tester 1965; Wymer 1985), which although disputed by some (eg Callow in Cruse 1987 for Cuxton) invites close comparison between these two sites and suggest a complex industrial sequence during OIS 10–9–8.

The dating evidence suggests that although these occurrences relate to two separate glacial–interglacial transitions, in both cases the Clactonian is associated with a period of climatic amelioration and is later replaced during the same interglacial by the

Acheulean (Table 1). There is at present no demonstrable temporal overlap between the two assemblage types in either period (cf Wymer 1988).

In terms of the Island Britain model, the Clactonian is associated with the initial recolonisation event of early phase 2 (late glacial peninsula), after which a period of residency is indicated. The Acheulean appears in a later part of phase 2 (interglacial peninsula), thus bringing to an end this period of exclusively Clactonian occurrences. The Clactonian may therefore be seen as a signature of early recolonisation. While *in situ* development of the Acheulean from the Clactonian is one way of interpreting the data (Wenban-Smith 1998), we suggest that the Clactonian and Acheulean in Britain represent distinct pulses of colonisation: the basic sequence, which occurs over two climatic cycles, recording a recurring pattern of diachronous colonisation following glacial abandonment. In other words, these two industries represent different 'traditions' of stone tool manufacture entering Britain at different times (cf Wymer 1968; 1974; Roe 1981; 1996). Evidence for pre-Anglian Acheulean assemblages thus becomes irrelevant to the Clactonian question. But from where, or how, did these different industries arise? Two possibilities are considered.

A long recognised pattern in the European Lower Palaeolithic record is the divide between a southern and south-western zone where handaxes are very abundant (eg, Spain, France, and Italy) and a northern, central and eastern zone (eg, the Lowlands, Germany, and Eastern Europe) where handaxes are very rare or completely absent during the earlier Middle Pleistocene (OIS 13–8) (cf Obermaier 1924; McBurney 1950; Gamble 1986; Bosinski 1995). The divide between these two 'provinces' is often expressed in terms of a line trending north-west to south-east and roughly corresponding to the course of the Rhine. Extensive research during the past 75 years has done little to change this remarkably robust pattern, especially with regard to the paucity of handaxes north and east of this line (Bosinski 1995). Sites in the latter region that do contain handaxes, such as Markkleeberg (Grahmann 1955; Mania & Baumann 1980), Salzgitter–Lebenstedt (Tode 1953) and Hundisberg (McBurney 1950; Toepfer 1961), also contain Levallois elements. Such sites are much younger in age, all post-dating OIS 8, and probably reflect changes in human behaviour at this time (Bosinski 1982; White & Pettitt 1996; Foley & Lahr 1997). Links between the Clactonian and European non-handaxe assemblages may sound familiar, having been forwarded by generations of prehistorians from Breuil, Warren and Oakley through to Wymer and Roe, but an adequate explanation of how these connections might be established and maintained has never been developed. The Island Britain model may hold the key to understanding the Clactonian, providing a mechanism which links it with mainland Europe and can also help to explain its temporal distribution.

Accepting that the geographical and temporal patterns highlighted above are real rather than artificial (see Gamble, 1986, 147) then they may suggest that the hominids who initially recolonised Britain immediately after the Anglian and following (OIS 10) glaciation originated from central and eastern Europe, representing a dispersal of populations from this essentially non-handaxe province (Breuil 1932). As the dominant archaeological signature in the latter region testifies, handaxe manufacture did not constitute a major, or at least frequently expressed, element in the technological repertoire of these hominids during the earlier Middle Pleistocene, with handaxes occurring very rarely, if ever, and then to a poorly maintained construct (ie, non-classics, see the examples from Karlich-Seeufer; Gaudzinski 1996). Any population dispersal originating from this part of Europe might justifiably be expected to leave an essentially non-handaxe signature, ie, that which in Britain is termed Clactonian. The introduction of the Acheulean might then possibly reflect a later colonisation event originating and expanding from the south (where, apparently, handaxes almost continuously flourished), with biface technology being introduced by different groups of hominids via areas of France. That this pattern is not found in the artefactual evidence from OIS 7 may relate to the widespread introduction of the Levallois technique (and possible behavioural changes) to north-west Europe just prior to this period (eg, Maastricht-Bélvèdere, the Netherlands; Roebroeks *et al.* 1992b; Purfleet; Wymer 1985; Bridgland 1994).

The Clactonian and Acheulean in Britain might thus be argued to reflect cultural signatures of colonisation and settlement by different regional populations with different technological repertoires. The problem operates on a regional scale, rather than a local or global one. Just as the Levant apparently witnessed colonisation and occupation by different African and European hominid populations at various times during the late Pleistocene, Britain, positioned at the far north-western edge of Europe and arguably frequently abandoned, also witnessed several population pulses over the course of the last 500 kyr.

Some may find this an unsatisfactory explanation which raises more questions than it answers, for example why the Acheulean apparently followed the Clactonian on two separate occasions. Several explanations can be forwarded, but unfortunately a straightforward solution is not forthcoming:

1. Physical barriers: even if not fully isolated, the incursion of the sea could have occurred more rapidly in the deeper Channel basin than in the southern North Sea (see Coles 1998, fig. 10), thereby restricting direct access for populations from the south over two cycles.
2. Ecological barriers: the appearance of the Acheulean in the Hoxnian seems to correspond with an episode of more open (but still temperate) conditions (cf Kerney 1971; Turner 1971; Wymer 1974; Conway *et al.* 1996; Schreve 1997). While this perhaps suggests some correlation between handaxe-making populations and open environments (Collins 1969; Wymer 1988; Mithen 1994), the pollen profile for Ho IIIa demonstrates the regeneration of mixed oak forest with the proportion of grasses in the mosaic only increasing significantly during Ho IV (Turner 1971). The mosaic character of the Pleistocene landscape should also be carefully considered. Furthermore, whether such a correlation exists for the subsequent climatic cycle remains to be demonstrated.
3. Distance factors: following the glacial maxima, populations from eastern, central and more northern refugia expanded most rapidly into the areas previously occupied by ice sheets and associated periglacial fronts (possibly rapidly reaching Britain via connected river systems), whilst those in more distant (and more genial?) southerly refugia remained in place.
4. Social barriers: once established, the pioneer populations presented a barrier to other hominid populations. This of course depends upon such factors as groups size, population densities, range defence and the exclusivity of the local hominid network (cf Gamble 1996; Gamble & Steele 1999).

Another important and very difficult question is why the earlier populations in the North German Plain, central and eastern Europe generally failed to maintain the rich biface technology seen in Spain, Italy, France and (periodically) in Britain, or, indeed, whether they ever possessed it. We find it hard to support the notion that these European non-handaxe populations formed part of a disjointed global techno-complex with meaningful or proximate socio-cultural links with the pebble-tool industries of south-east Asia. Immediate adaptive responses to poor raw materials among otherwise Acheulean populations may provide an adequate explanation on a short-term, local scale, but it is difficult to accept this as the whole story for entire regions of Europe over 300 kyr of (periodic) occupation; especially given the later appearance of handaxes in these regions (this, though, could relate to changes in available raw material over time). Longer term adaptive and social factors, incorporating responses in hominid technical practices to specific regional conditions and the fashion in which technology was socially mediated through space and time ('traditions'), probably played a significant role (cf Mithen 1994; 1996; McBurney 1950; Collins 1969). Assemblages in the non-handaxe province might represent technologically impoverished variants of the Acheulean (Narr 1953, cited in Narr 1979), originally related to contingencies encountered during pioneering phases of recolonisation by small, isolated groups following the inferred abandonment of Northern Europe during glacial maxima (cf Toth & Schick 1993; Aldhouse-Green 1998, 143).

The latter suggestion provides our second explanation for the Clactonian that removes the need to link it directly to any other European non-handaxe assemblage. It is possible that the Clactonian relates to the social and environmental conditions experienced by handaxe-making populations during a pioneer phase of colonisation. Hypothetically, if the earliest populations to settle Britain at the end of OIS 12 and OIS 10 were characterised by small groups, isolated on the periphery and in restricted enclaves, then this social environment might have led to a flux in the channels of cultural transmission similar to those proposed by Mithen (1994), causing handaxes to largely phase out of use in only a small number of generations. Later groups that introduced the Acheulean may have been larger, with stronger channels of learning and larger alliance networks, allowing them to disperse and settle with no deleterious effects on the transmission of technology. Wenban-Smith (1996) has similarly suggested that the Clactonian relates to the effects of social splintering on cultural transmission during the height of the Anglian glaciation, with 'regrouping' during the later Hoxnian allowing the re-introduction of the Acheulean. To accept any of these arguments, however, we need to more closely define the mechanisms of colonisation, explain why Clactonian demographics should be different from Acheulean ones and understand the reasons why the Acheulean is so poorly represented in large parts of Europe north-east of the Rhine (see Mithen 1994; Toth & Schick 1993 for some hypotheses). However, in this regard it is interesting to note that in other parts of the Old World, for example at Ubeidiya, Israel (Bar-Yosef & Goren-Inbar 1993; Bar-Yosef 1994), Atapuerca, Spain (Carbonnell & Rodríguez 1994) and Monte Poggiolo, Italy (Peretto *et al.* 1998) the earliest claimed evidence for human occupation appears to commence with a non-handaxe phase. These are clearly issues in need of further attention.

Such interpretations do not advocate a return to notions of separately evolving parallel phyla with rigid culture-groups ethnically defined and linked in time and space by their lithic material culture. Rather it sees fluid regional and local populations whose material culture at different points in time varies by virtue of social and demographic factors, long-term technological adaptations, convergence and, perhaps most importantly, social distance – to what extent they shared a common proximate history, a common landscape, or a common body of socially transmitted knowledge (Mellars 1996). The difference is subtle but important. Similar regional traditions seem to exist even within chimpanzee material culture (Whiten *et al.* 1999) and certainly within the Middle Palaeolithic (Mellars 1996; Bosinski 1982). The Clactonian is more than an immediate *ad hoc* response to site-level conditions or a parochial concern but a complex phenomenon that needs to be examined in terms of population histories, local and regional patterns of adaptive variability, colonisation patterns and dynamics, and the social interaction between hominid populations at different scales. The importance of these factors (often under different names) during the early decades of the 20th century and the tendency amongst modern archaeologists to ignore them has recently been summarised by Foley and Lahr (1997), whose own model for Mode 3 technologies emphasises population histories and dispersal. The Island Britain model also stresses the point that not all non-handaxe assemblages need have the same explanation. Whilst function and raw materials can undoubtedly explain some non-handaxe assemblages in terms of expedient responses by otherwise Acheulean populations (Rolland 1998; as probable examples, the use of small marine beach pebbles at the site of Quarto delle Cinfonare (Peretto *et al.* 1997) and in the Colombanien sites on the ancient raised beach deposits of Brittany (Monnier & Molines 1993) undoubtedly influenced the production of formal tools at these locations), they do not necessarily explain them all.

ISLAND BRITAIN AND HANDAXE TYPOLOGY

The problems of using handaxe typology as a dating tool are widely recognised (Wymer 1991), while its value as a cultural indicator, or an expression of different traditions of manufacture, has also been strongly questioned (White 1998a). Indeed, most recent work on handaxes has concentrated on the effects of such factors as raw materials (White 1998a; Ashton & McNabb 1994), reduction (McPherron 1994), or function (Mitchell 1996). Yet, while some of these studies have produced convincing results, they do not preclude the possibility that patterns relevant to social traditions may exist at some level. Again, one of the biggest problems in identifying such patterns is accurate dating but so too is the identification of suitable attributes. Gross measures of shape and technical sophistication are inadequate as these are too often reliant on factors such as raw material packages and basic functional requirements. Lesser features which can be demonstrated to vary independently of raw materials, which even if serving a specific function were clearly not used by all hominid populations under similar circumstances, might be more suitable measures. One example of such a feature is the twisted edges of some ovates and cordates (White 1998b).

Twisted ovate handaxes occur in low or very low frequencies in many British handaxe assemblages; in these cases they possibly represent the accidental or occasional expression of a rare knapping technique (see Roe 1968; White 1998b). In some assemblages, however, twisted ovates dominate the entire handaxe series, or the ovate element within that series. These include a number of primary context assemblages: Upper Loam, Barnfield Pit, Swanscombe (Roe 1968; Bridgland 1994); Rickson's Pit, Swanscombe (Wymer 1968; Roe 1981; Bridgland 1994); Wansunt Pit, Dartford (White, 1996; Bridgland 1994; White *et al.* 1995); Bowman's Lodge, Dartford (Roe 1968; Bridgland 1994); Elveden, Suffolk (Roe 1968; White, 1996; Nick Ashton, pers. comm. 1998); the Hitchin Lake Beds, Hertfordshire (Roe, 1968; Boreham & Gibbard 1995); and Foxhall Road, Ipswich, Suffolk (Roe, 1968; Wymer 1985). On current evidence, these assemblage can all be correlated on independent criteria with the late Hoxnian interglacial (OIS 11) and/or the early part of the subsequent glacial period (OIS 10) (see White 1998b and references therein). Some secondary context sites with large numbers of twisted ovates, or at least the handaxes contained within these contexts, may also be tentatively attributed to this period, for example the abraded handaxes from the lower gravel at Sturry, Kent (Bridgland *et al.* 1999) and at Santon Downham, Suffolk. So, the problems of sampling and accurate dating notwithstanding, sites where production was heavily geared towards twisted ovates seem to cluster temporally, but not spatially, in the British sequence. Most importantly, they cluster during the late Hoxnian island phase.

The earliest Acheulean assemblages dating to the Hoxnian interglacial, such as the Swanscombe Middle Gravels (Wymer 1964) and the Hoxne Lower Industry (Wymer & Singer 1993; Schreve 1997; 2000), have yielded some ovate handaxes, but very few are notably twisted (although Swanscombe and Hoxne do show significant percentages of pointed handaxes with 'twisted tips'; Roe 1968). Moreover, twists are almost unknown in pre-Hoxnian sites such as Boxgrove (Roberts 1986; Roberts *et al.* 1997), Warren Hill (Roe 1968; Wymer et al. 1991), or High Lodge (Ashton *et al.* 1992) and are very infrequent in contexts that can be unequivocally shown to post-date the Hoxnian. This distribution stands in contrast to that observed at sites in northern France where assemblages yielding high proportions of twists occur sporadically from OIS 12 through to OIS 8 (Tuffreau & Antoine 1995; Callow 1986) but do not seem restricted to any particular period and are perhaps of only local significance at any given time.

That an apparent proliferation of a well-defined, highly specific knapping technique and resultant typological form should correspond with a period during which we strongly believe Britain was isolated from Europe hints at exactly the sort of endemic cultural developments expected in the Island Britain framework. Of course, assuming that the Acheulean was an exogenous introduction, it is possible that twisted ovates were already common among some of the earliest handaxe-making populations who entered Britain during the Hoxnian. The later insularity would thus be a largely coincidental factor, but one which may have worked to sustain this pattern through isolation. The aforementioned Acheulean assemblages from Swanscombe and Hoxne, where twists are rare or absent, argue against this however; although the fact that the twisted technique can be documented much earlier in France may provide some circumstantial evidence for the proposed migration routes of Clactonian and Acheulean populations. An alternative explanation posits that, prior to separation, the twisted knapping strategy was only a minor variant within a diverse handaxe repertoire (possibly already widespread in some local populations). Upon separation, however, this technique was transmitted in increasing frequencies via the vagaries of social learning such as drift (Isaac 1972) or biased learning (Boyd & Richerson 1985), eventually filtering through adjacent local networks of a small, isolated and essentially closed regional population, finally coming to dominate production over a large area. In this way, the proliferation of twisted ovates in the British record can be seen as a largely endogenous development, directly related to insularity, but taking place in the social sphere. With the abandonment of Britain during the following glacial maximum, the twisted technique practically vanished and never again assumed such status.

The key point here, though, is not to establish the precise mechanisms by which such a pattern may have emerged but to stress that the only typological and technological structure currently identified in the British Acheulean that arguably represents a regional tradition of manufacture and not a response to local raw materials (White 1998a; 1998b) apparently corresponds with a period of isolation. This indicates that the Island Britain model is a useful tool for examining and understanding the meaning of chronologically-defined patterns of lithic manufacture in Britain. It further implies that with accurate dating and the use of an expanded chronology, significant patterns may emerge from a Lower Palaeolithic record that had previously been believed to show little or no temporal patterning.

CONCLUSIONS

This paper has reviewed the evidence for Britain's fluctuating geographical status during the Middle Pleistocene. This has been used to construct a biogeographical framework of human colonisation, settlement, and abandonment, proposing mechanisms that are coupled with regional palaeogeographical evolution and global climatic change. When applied to the archaeological record, the model suggests (contrary to much current opinion) not only that patterns pertaining to distinct, chronologically defined traditions of manufacture may exist, but that, in Britain at least, we may be able to access and understand some of them as part of the differential ebb and flow of different regional populations. We suggest that the Clactonian and Acheulean reflect separate pulses of colonisation. The Clactonian is argued to represent the early expansion of European populations into Britain during the early post-glacial period (phase 2) following abandonment during the glacial maxima (phase 1). These populations may have originated from areas of Europe where handaxes were always scarce during the earlier Middle Pleistocene. A second wave of colonisation, which introduced the Acheulean, occurred later possibly originating in south and south-west Europe. These phenomena are observable during both the Hoxnian and the succeeding interglacial (OIS 9) in Britain. The possibility that the Clactonian reflects changes in hominid social organisation and tool behaviour during pioneering phases of colonisation is also briefly considered. Periods of isolation from mainland Europe (phase 3) are argued to have permitted the development of endemic traditions, represented by forms such as twisted ovates. As more well-dated sites become available, more patterns of this type may become apparent. The Clactonian is not evident in the OIS 8–7 climatic amelioration due to the widespread adoption of the Levallois technique and accompanying changes in human behaviour prior to this event.

The Island Britain model provides an heuristic framework against which to study the colonisation and settlement history of Britain in terms of regional population dynamics and the wider European landscape. It approaches the British Palaeolithic record on a large scale and highlights patterns of potential social and cultural significance, in contrast to other recent works which have focused almost exclusively on functional or economic factors. These approaches are not mutually exclusive, but operate on different scales of analyses, some of which are more applicable to certain problems and types of data than others. As the data are increased and methodologies developed that are capable of coupling these differential scales, models such as this may provide an inroad through which the current theoretical issues surrounding Palaeolithic society, cultural traditions and the mechanics of social transmission on an individual, local and regional scale can be addressed.

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